

CRJ-700 Alerting Issues – Hydraulics failure (single system)

1. Initiating Condition: Complete fluid loss for the single most critical hydraulic system (3), in cruise flight

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution light will flash	Yellow EICAS message "HYD 3 LO PRESS"	Depending on which system fails, other downstream failures may also produce a single chime caution message	The pilots have to be aware that there are separate QRH checklists for multiple hydraulic system failures.	All hydraulic messages are inhibited during takeoff except "HYD LO PRESS"	Pressing the master caution switchlight will stop flashing
	Yellow EICAS message "HYD 3 LO PRESS"	When both pumps have a pressure output below 1800 psi	There is no low quantity EICAS message. Depleted quantity will eventually result in low pressure message.	The pilots have to be aware that there are separate QRH checklists for multiple hydraulic system failures. ; Other downstream failures may occur as the result of this failure. For example, hydraulic temp. increase and/or pump failure. All of these produce corresponding indications on the EICAS and hydraulic synoptic page in addition to a single caution chime; Since there is no low quantity EICAS message it is possible to mis-diagnose the original issue if viewed first from the synoptic page. There is no low quantity checklist.	All hydraulic messages are inhibited during takeoff except "HYD LO PRESS"	The single chime caution switch light will be flashing until pushed. The malfunction is not terminated until repaired. Otherwise the indication remains active as the hydraulic condition continues through the end of the flight.
Aural Alerts	Master caution message single chime	When system pressure is below 1800 psi	Depending on which system fails, other downstream failures may also produce a single chime caution message			None, only a single chime, does not repeat unless another caution message is presented.
Tactile Alerts	None					

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Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Cues	On the hydraulic synoptic page the reservoir will change color and show a lower quantity when low or empty.	When the system pressure drops below 1800 psi.		The QRH procedure will cause additional EICAS indications to occur as a normal part of managing the system. Pilot action is required to display the synoptic page on the MFD.		
	On the hydraulic synoptic page the hydraulic line from the reservoir will change color when pressure is too low.	When the system pressure drops below 1800 psi.		Pilot action is required to display the synoptic page on the MFD.		
	On the hydraulic synoptic page below the hydraulic lines, the current pressure is displayed and as it decreases, the numbers and the box they are in will change different colors depending on the amount of pressure.	When the system pressure drops below 1800 psi.		Pilot action is required to display the synoptic page on the MFD.		
	On the hydraulic synoptic page below the pressure reading, any systems that are no longer operative, the system names will turn yellow. Showing what you have lost.	When the system pressure drops below 1800 psi.		Pilot action is required to display the synoptic page on the MFD.		

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Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Cues	On the hydraulic synoptic page above the system pressure reading and the quantity indicator, the current brake line pressure is indicated. If it drops below 1800 psi, the numbers will turn yellow. Both inboard and outboard brake line pressures are indicated.			Pilot action is required to display the synoptic page on the MFD.		
Aural Cues	None					
Tactile/ Somatic Cues	Nosewheel shimmy may be felt in addition to reduce braking effectiveness					

Expected Pilot Response(s)

- Identify condition
- Follow the correct QRH procedure and comply with any stated restrictions.
- Pilots will need to plan for operational challenges as part of the failure of this system. These include, L & R ground spoilers inop, inboard brakes inop once the accumulator is depleted, normal landing gear extension and retraction are inop, nose wheel steering is inop, and the parking brake is inop. The procedure also requires a flaps 20 landing.
- Due to the failures listed above, pilots will need to increase landing distances by 100% without thrust reversers and 70% with one thrust reverser. These will have implications for landing, potential go-around, terrain considerations with gear out, and diversion requirements with gear out and max speed of 250kts.
- Instead of crews figuring landing distance based on highest weight allowed, now they will have to figure actual landing distance and apply corrections for spoiler failure, brake failure, and flap 20 landing. None of these required calculations are mentioned in the QRH with the exception of the HYD Press low recalculation of 1.7Xs or 2.0xS.

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Possible sources of confusion with regard to pilot response(s)

- Different system failures, 1,2, or 3 all produce different types of failures in other systems.
- Not realizing that there are separate checklists when multiple hydraulic systems have failed. Even if another system fails while still completing a single system failure checklist, QRH states stop and go to multiple system failure checklist
- Cat II operations may be affected but QRH says to "Review the requirements" but does not say where to look.
- "Land at nearest suitable" airport notation in QRH checklist may be interpreted differently by different pilots.
- The maximum crosswind component is reduced to 15 knots but is not listed in QRH, only POH
- Landing on a contaminated runway is prohibited but not listed in QRH, only POH
- The following warning is in the POH but not the QRH. "Increase the first segment net height above reference zero, determined from the chart, by 50 feet"

How does pilot know condition is resolved/recovered?

- Situation will not be resolved until bringing the aircraft to a stop on the ground.

Issues with regard to multiple concurrent non-normal conditions

- Not realizing that there are separate checklists when multiple hydraulic systems have failed. Even if another system fails while still completing a single system failure checklist, FCOM states stop and go to multiple system failure checklist.
- System 3 failure will also produce "IB GND SPLRS" and "IB BRAKE PRESS" messages which require no action on the part of the pilot. No need to follow those QRH checklists.